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(54) Title: CHEWING GUM PRODUCTS CONTAINING NISIN AND METHODS OF PREPARATION

(57) Abstract

The use of low levels of nisin polypeptide in both sugar and surgarless chewing gums improves sensory characteristics. In sugar gum, nisin improves flavor and suppresses bitterness. In sugarless gum, nisin enhances flavor and improves mouth feel, making sugarless gum taste more like sugar gum. Nisin also reduces bitterness in chewing gums containing high-intensity sweeteners.

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CHEWING GUM PRODUCTS CONTAINING NISIN AND METHODS OF PREPARATION

BACKGROUND OF THE INVENTION

This invention relates generally to chewing gum products and, in particular, to chewing gum products which utilize a small amount of the polypeptide nisin to suppress bitterness and to enhance flavor. The use of nisin in food products and, in particular, chewing gum, has been suggested in U.S. Patent No. 5, 043,176 and PCT Patent Publication Nos. WO 93/11738, WO 94/05251, and WO 94/12150. These patents, however, use nisin in levels sufficient for preventing dental caries and/or gingivitis and for fighting bacteria in the oral cavity.

Chewing gum compositions typically include gum base, flavoring, and bulking and sweetening agents, as well as other optional ingredients such as softeners and coloring. Bulking and sweetening agents often include high-intensity sweeteners, which are most commonly used in conjunction with sugarless sweeteners. High-intensity sweeteners characteristically impart a bitterness to chewing gum products in which they are found.

Proteins and polypeptides may also be present in chewing gum compositions. However, polypeptides and proteins generally suppress flavors of chewing gum products and provide a dry mouth feel.

A need, therefore, exists for a method of suppressing the bitterness and enhancing the flavor characteristics of chewing gum products. Even more beneficial would be a method for the use of high-intensity sweeteners in chewing gum products without the resulting bitterness that high-intensity sweeteners cause.

SUMMARY OF THE INVENTION

The present invention relates to a method of suppressing bitterness and enhancing flavor of chewing gum products by adding a minor amount of nisin to the chewing gum composition. The invention also includes chewing gum products with nisin added in minor amounts.

In a first embodiment, the invention is a chewing gum product having an improved flavor comprising:

a) about 5% to about 95% gum base;

b) about 5% to about 95% bulking and sweetening agents;

c) about 0.1% to about 15% flavor; and

d) a minor amount of nisin, the nisin being present in an amount sufficient to provide the gum product with a suppressed bitterness and an enhanced flavor.

In a second embodiment, the invention is a method of making a chewing gum product with improved flavor comprising the steps of:

a) mixing about 5% to about 95% gum base, about 5% to 95% bulking and sweetening agents, and about 0.1% to about 15% flavor to form a chewing gum composition; and

b) while making the gum composition, adding nisin in an amount sufficient to provide the gum composition with a suppressed bitterness and an enhanced flavor.

In other aspects of the invention, the nisin is added to (1) a center fill used in a liquid center chewing gum product, (2) a dusting or rolling compound applied to a chewing gum composition, or (3) a coating, such as a hard shell coating, applied to a chewing gum product.

According to the present invention, minor amounts of nisin are added to chewing gum products. The unexpected result is that nisin provides flavor enhancement by improving sensory properties. These properties include suppressed bitterness, especially in sugarless gum where high-

intensity sweeteners are used, and a syrupy mouth feel that makes for improved sweetness and mouth coating.

The foregoing and other features and advantages will become apparent from the following detailed description of the presently preferred embodiments, when read in conjunction with the accompanying examples.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

As used herein, the term "chewing gum" also includes bubble gum and the like. All percentages are weight percentages unless otherwise specified.

The polypeptide nisin is the antimicrobial substance produced by Lancefield Group N *Lactococcus lactis*. Nisin producing strains of *L.lactis* occur widely in nature and are frequently found in raw milk throughout the world. Nisin is used as a preservative in processed cheeses, dairy products, and various other types of products. Nisin is approved in the United States for use in pasteurized process cheese and pasteurized process cheese spreads and in modified standard food products.

According to the present invention, the flavor of a chewing gum composition, preferably comprising gum base, flavoring, and bulking and sweetening agents, is enhanced by adding nisin, generally in an amount ranging from about 12.5 ppm to about 187.5 ppm, preferably from about 25 ppm to about 125 ppm, by weight of the chewing gum product.

Nisin is the active polypeptide constituent in the commercial product, Nisaplin. Nisaplin is a preservative used for the control of bacterial spoilage in heat-processed foods. Nisaplin comprises about 23.8% denatured milk solids, about 74.5% sodium chloride, and about 2.5% (1×10^6 iu/g) nisin. Nisaplin is prepared from the *L.lactis* fermentation of a nonfat milk medium. The nisin produced is concentrated, separated, and spray-dried before being milled into fine particles which are standardized by the addition of sodium chloride. Nisaplin is available from Integrated Ingredients, Rosemont, Illinois.

In accordance with the invention, small amounts of Nisaplin can be used in chewing gum compositions to yield chewing gum products with suppressed bitterness and enhanced sensory properties. The quantity of Nisaplin present in the chewing gum product ranges from about 0.05% to about 0.75%, preferably from about 0.1% to about 0.5%, by weight of the chewing gum product. Even though Nisaplin includes salt, it is believed that the small amount of salt in the Nisaplin, when added at these small percentages, is not responsible for the improved sensory properties in the chewing gum products.

A typical chewing gum generally includes a water soluble bulk portion, a water insoluble chewing gum base portion, and one or more flavoring agents. The water soluble portion dissipates over a period of time during chewing. The gum base portion is retained in the mouth throughout the chewing process.

The insoluble gum base generally includes elastomers, elastomer plasticizers (resins), fats, oils, waxes, softeners, and inorganic fillers. The elastomers may include polyisobutylene, isobutylene-isoprene copolymer, styrene butadiene copolymer, and natural latexes such as chicle. The resins may include polyvinyl acetate and terpene resins. Low molecular weight polyvinyl acetate is a preferred resin. Fats and oils may include animal fats such as lard and tallow, vegetable oils such as soybean and cottonseed oils, hydrogenated and partially hydrogenated vegetable oils, and cocoa butter. Commonly used waxes include petroleum waxes such as paraffin and microcrystalline wax, natural waxes such as beeswax, candellia, carnauba, and polyethylene wax.

The gum base typically also includes a filler component such as calcium carbonate, magnesium carbonate, talc, dicalcium phosphate and the like; softeners, including glycerol monostearate and glycerol triacetate; and optional ingredients such as antioxidants, color, and emulsifiers. The gum base constitutes between 5-95% by weight of the

chewing gum composition, more typically 10-50% by weight of the chewing gum, and most commonly 20-30% by weight of the chewing gum.

The water soluble portion of the chewing gum may include softeners, bulk sweeteners, high-intensity sweeteners, flavoring agents, and combinations thereof. Softeners are added to the chewing gum in order to optimize the chewability and mouth feel of the gum. The softeners, which are also known as plasticizers or plasticizing agents, generally constitute between about 0.5-15% by weight of the chewing gum. The softeners may include glycerin, lecithin, and combinations thereof. Aqueous sweetener solutions such as those containing sorbitol, hydrogenated starch hydrolysates, corn syrup, and combinations thereof may also be used as softeners and binding agents in chewing gum.

Bulk sweeteners constitute between 5-95% by weight of the chewing gum, more typically 20-80% by weight of the chewing gum and most commonly 30-60% by weight of the chewing gum. Bulk sweeteners may include both sugar and sugarless sweeteners and components. Sugar sweeteners may include saccharide containing components including but not limited to sucrose, dextrose, maltose, dextrin, dried invert sugar, fructose, levulose, galactose, corn syrup solids, and the like, alone or in combination. Sugarless sweeteners include components with sweetening characteristics but are devoid of the commonly known sugars. Sugarless sweeteners include but are not limited to sugar alcohols such as sorbitol, mannitol, xylitol, hydrogenated starch hydrolysates, maltitol, and the like, alone or in combination.

High-intensity sweeteners may also be present and are commonly used with sugarless sweeteners. When used, high-intensity sweeteners typically constitute between 0.001-5% by weight of the chewing gum, preferably between 0.01-1% by weight of the chewing gum. Typically, high-intensity sweeteners are at least 20 times sweeter than sucrose.

These may include, but are not limited to sucralose, aspartame, salts of acesulfame, alitame, saccharin and its salts, cyclamic acid and its salts, glycyrrhizin, dihydrochalcones, thaumatin, monellin, and the like, alone or in combination.

Combinations of sugar and/or sugarless sweeteners may be used in chewing gum. The sweetener may also function in the chewing gum in whole or in part as a water soluble bulking agent. Additionally, the softener may provide additional sweetness, such as when aqueous sugar or alditol solutions are used in the gum composition.

Flavor should generally be present in the chewing gum in an amount within the range of about 0.1-15% by weight of the chewing gum, preferably between about 0.2-5% by weight of the chewing gum, most preferably between about 0.5-3% by weight of the chewing gum. Flavoring agents may include essential oils, synthetic flavors or mixtures thereof, including but not limited to oils derived from plants and fruits such as citrus oils, fruit essences, peppermint oil, spearmint oil, other mint oils, clove oil, oil of wintergreen, cinnamon, anise, and the like. Artificial flavoring agents and components may also be used in the flavor ingredient of the invention. Natural and artificial flavoring agents may be combined in any sensorially acceptable fashion.

Optional ingredients such as colors, emulsifiers, pharmaceutical agents, and additional flavoring agents may also be included in chewing gum.

Because nisin is an antimicrobial agent used in a variety of food products, it may also act as an antimicrobial agent in the mouth during gum chewing. When added to sugar gum, nisin may be effective to reduce the activity of *S Mutans* bacteria in the mouth. *S Mutans* form acids in the mouth that reduce plaque pH that, in turn, contributes to dental caries.

Fast release of nisin may be required for nisin to actively inhibit *S Mutans*. At low usage levels, some

polypeptides and proteins, because of their molecular size, may have a slow release from the chewing gum matrix. As a result, these materials, such as nisin, may not be released quickly enough into the mouth to be effective as a flavor modifier or an antimicrobial agent. One such protein that has a slow sweetness release is the high-intensity sweetener/flavor enhancer known as thaumatin. U.S. Patent No. 4,562,076 discloses adding thaumatin in a rolling compound, in which form, at lower levels, it is more effective as a sweetening agent than it is when added to the gum matrix. In the same way, nisin may also be more effective as a flavor enhancer and an antimicrobial agent if added in a rolling compound. Also, a fast release may be accomplished by encapsulating nisin with a fast release agent, or by adding nisin to the liquid center of a liquid center gum product. On the other hand, there may be gum formulations in which release of the nisin is preferably delayed, such as when the high-intensity sweetener in the composition also has a delayed release.

Physical modifications of Nisaplin by encapsulation with another substrate will speed or slow its release in chewing gum by modifying the solubility or dissolution rate. Any standard technique which gives partial or full encapsulation of the bulk sweetener can be used. These techniques include, but are not limited to, spray drying, spray chilling, fluid-bed coating and coacervation. These encapsulation techniques that give partial encapsulation or full encapsulation can be used individually or in any combination, in a single step process or multiple step process.

The encapsulation techniques here described are standard coating techniques and generally give varying degrees of coating from partial to full coating, depending on the coating composition used in the process. Also, the coating compositions may be susceptible to water permeation to various degrees. Generally, compositions that have high organic solubility, good film-forming properties and low

water solubility give better delayed release. Such compositions include acrylic polymers and copolymers, carboxyvinyl polymer, polyamides, polystyrene, polyvinyl acetate, polyvinyl acetate phthalate, polyvinylpyrrolidone, and waxes. Although all of these materials are possible for encapsulation, only food-grade material should be considered. Two standard food-grade coating materials that are good film formers but not water soluble are shellac and Zein. Others which are more water soluble, but good film formers, are materials like agar, alginates, a wide range of cellulose derivatives like ethyl cellulose, methyl cellulose, sodium hydroxymethyl cellulose, and hydroxypropylmethyl cellulose, dextrin, gelatin, and modified starches. These ingredients, which are generally approved for food use, also give a modified release when used as an encapsulant. Other encapsulants like acacia or maltodextrin can also encapsulate Nisaplin and may increase the release rate of the material.

Another method of giving a modified release rate of Nisaplin is agglomeration with an agglomerating agent which partially coats Nisaplin. This method includes the step of mixing Nisaplin and agglomerating agent with a small amount of water or solvent. The mixture is prepared in such a way as to have individual wet particles in contact with each other so that a partial coating can be applied. After the water or solvent is removed, the mixture is ground and used as a powdered, coated material.

Materials that can be used as the agglomerating agent are the same as those used in encapsulation mentioned previously. Some of the better agglomerating agents are the organic polymers like acrylic polymers and co-polymers, polyvinyl acetate, polyvinylpyrrolidone, waxes, shellac, and Zein. Other agglomerating agents are not as effective in giving Nisaplin a modified release as are the polymers, waxes, shellac and Zein. These other agglomerating agents include, but are not limited to, agar, alginates, a wide range of cellulose derivatives like ethyl cellulose, methyl

cellulose, sodium hydroxymethyl cellulose, hydroxypropyl-methyl cellulose, dextrin, gelatin, modified starches, vegetable gums like guar gum, locust bean gum, and carrageenin.

Nisaplin may be coated in a two-step process or multiple step process. Nisaplin may be encapsulated with any of the materials as described previously and then the encapsulated Nisaplin can be agglomerated as described previously to obtain an encapsulated/agglomerated Nisaplin product.

In another embodiment of this invention, Nisaplin may be absorbed onto another component which is porous and become entrapped in the matrix of the porous component. Common materials used for absorbing Nisaplin include, but are not limited to, silicas, silicates, pharmasorb clay, sponge-like beads or microbeads, amorphous sugars like spray-dried dextrose, sucrose, alditols, amorphous carbonates and hydroxides, including aluminum and calcium lakes, vegetable gums and other spray dried materials.

Depending on the type of absorbent material and how it is prepared, the amount of Nisaplin that can be loaded onto the absorbent will vary. Generally, materials like polymers, sponge-like beads or microbeads, amorphous sugars and alditols and amorphous carbonates and hydroxides absorb about 10% to about 40% of the weight of the absorbent. Other materials like silica and pharmasorb clays may be able to absorb about 20% to about 80% of the weight of the absorbent.

The three methods of use to obtain a modified release of Nisaplin are: (1) encapsulation by spray drying, fluid-bed coating, spray chilling and co-acervation to give full or partial encapsulation, (2) agglomeration to give partial encapsulation, and (3) fixation or entrapment/absorption which also gives partial encapsulation. These three methods, combined in any usable manner which physically isolates Nisaplin and modifies its dissolvability or release rate, are included in this invention.

Other methods of treating Nisaplin to physically isolate Nisaplin from other chewing gum ingredients may also have some effect on its release rate and its effect on chewing gum flavor and texture. Nisaplin may be added to the liquid inside a liquid center gum product. The center fill of a gum product may comprise one or more carbohydrate syrups, glycerin, thickeners, flavors, acidulants, colors, sugars, and sugar alcohols in conventional amounts. The ingredients are combined in a conventional manner. Nisaplin is mixed in the center-fill liquid and the amount of Nisaplin added to the center-fill liquid is preferably about 0.01% to about 0.5% by weight of the entire chewing gum formula. This method of using Nisaplin in chewing gum can allow for a lower usage level of the bulk sweetener, can give a fast release rate, and can reduce or eliminate any possible reaction of Nisaplin with gum base, flavor components or other components, yielding improved shelf stability.

As noted earlier, another method of isolating Nisaplin from other chewing gum ingredients is to add Nisaplin to the dusting compounds of a chewing gum. A rolling or dusting compound is applied to the surface of chewing gum as it is formed. This rolling or dusting compound serves to reduce sticking to machinery as it is formed, reduces sticking of the product to machinery as it is wrapped, and sticking to its wrapper after it is wrapped and stored. The rolling compound comprises Nisaplin in combination with mannitol, sorbitol, sucrose, starch, calcium carbonate, talc, and other orally acceptable substances or a combination thereof. The rolling compound constitutes from about 0.25% to about 10.0%, but preferably about 1% to about 3% of the chewing gum composition. The amount of Nisaplin added to the rolling compound is preferably about 0.01% to 1.0% of the rolling compound or about 10 ppm to about 300 ppm of the chewing gum composition. This method of using Nisaplin in the chewing gum can allow a lower usage level of Nisaplin, can give Nisaplin a more controlled release

rate, and can reduce or eliminate any possible reaction of Nisaplin with gum base, flavor components, or other components, yielding improved shelf stability.

Another method of isolating Nisaplin is to use it in the coating/panning of a pellet chewing gum. Pellet or ball gum is prepared as conventional chewing gum, but formed into pellets that are pillow-shaped or into balls. The pellets/balls can then be sugar coated or panned by conventional panning techniques to make a unique sugar-coated pellet gum. Nisaplin can easily be added to a sugar solution prepared for sugar panning. Nisaplin may be combined with sucrose in solution as the coating on pellet gum. Nisaplin can also be added as a powder blended with other powders often used in some types of conventional panning procedures. This isolates Nisaplin from other gum ingredients and modifies its release rate in chewing gum. Levels of use of Nisaplin will preferably be about 0.01% to about 1.0% in the coating and about 10 ppm to about 1000 ppm of the weight of the chewing gum product. The weight of the coating will generally be about 20% to about 50% of the weight of the finished gum product.

Conventional panning procedures generally coat with sucrose, but recent advances in panning have allowed the use of other carbohydrate materials to be used in the place of sucrose. Some of these components include, but are not limited to, dextrose, maltose, xylitol, lactitol, palatinit and other new alditols or a combination thereof. These materials may be blended with panning modifiers, including, but not limited to, gum arabic, maltodextrins, corn syrup, gelatin, cellulose type materials like carboxymethyl cellulose, or hydroxymethyl cellulose, starch and modified starches, vegetable gums like alginates, locust bean gum, guar gum, and gum tragacanth, insoluble carbonates like calcium carbonate or magnesium carbonate and talc. Antitack agents may also be added as panning modifiers which allow the use of a variety of carbohydrates and sugar alcohols to be used in the development of new panned or

coated gum products. Flavors may also be added with the sugar coating to yield unique product characteristics.

A wide range of changes and modifications to the embodiments of the invention described above will be apparent to persons skilled in the art. The following examples are not to be construed as imposing limitations on the invention, but are included merely to illustrate preferred embodiments.

EXAMPLES 1-4

A cinnamon flavored chewing gum composition was prepared according to the following formula:

Ingredient	% By Weight
Gum Base	19.5
Sugar	62.2
Corn Syrup	15.6
Glycerin	0.7
Flavor	1.4
Color	0.6
TOTAL	100.0

The above chewing gum composition was divided into four 50 gram portions. The portions were then mixed with levels of 0.1%, 0.25%, 0.5%, and 1.0% Nisaplin. Sensory evaluation of the chewing gum indicated that levels of 0.1% and 0.25% Nisaplin gave reduced bitterness and improved syrup sweetness. Higher levels of Nisaplin imparted a salty taste to the chewing gum.

EXAMPLES 5-8

A spearmint flavored chewing gum composition was prepared according to the following formula:

Ingredient	% By Weight
Gum Base	20.7
Sugar	54.2
Corn Syrup	13.2
Dextrose Monohydrate	10.1
Glycerin	1.2
Flavor	0.6
TOTAL	100.0

The above chewing gum composition was divided into four 50 gram portions. The portions were then mixed with

levels of 0.1%, 0.25%, 0.5%, and 1.0% Nisaplin. Sensory evaluation of the chewing gum again indicated that levels of 0.1% and 0.25% Nisaplin gave reduced bitterness and improved syrup sweetness. Higher levels of Nisaplin imparted a salty taste to the spearmint flavored chewing gum as well.

EXAMPLES 9-12

A fruit flavored chewing gum was prepared having the following composition:

Ingredient	% By Weight
Gum Base	19.3
Sugar	57.4
Corn Syrup	13.9
Dextrose Monohydrate	7.3
Glycerin	1.2
Lecithin	0.1
Fruit Flavor	0.8
TOTAL	100.0

The above chewing gum composition was divided into four 50 gram portions. The portions were then mixed with levels of 0.1%, 0.25%, 0.5%, and 1.0% Nisaplin. Sensory evaluation of the chewing gum again indicated that levels of 0.1% and 0.25% Nisaplin gave reduced bitterness and improved syrup sweetness. Higher levels of Nisaplin imparted a salty taste to the fruit flavored chewing gum as well.

EXAMPLES 13-16

A sugarless bubble gum was prepared according to the following formula:

Ingredient	% By Weight
Bubble Gum Base	32.60
Sorbitol	41.00
Mannitol	8.00
Coevaporated Lycasin\Glycerin*	9.10
Glycerin	6.30
Bubble Gum Flavor	2.15
Encapsulated High-Intensity Sweeteners	0.60
Color	0.15
10% Salt Solution**	0.10
TOTAL	100.00

* Contains about 67.5% Lycasin brand hydrogenated starch hydrolate solids, about 25% glycerin, and about 7.5% water

** Contains 10% sodium chloride and 90% water

The above chewing gum composition was divided into four 50 gram portions. The portions were then mixed with levels of 0.1%, 0.25%, 0.5%, and 1.0% Nisaplin. Sensory evaluation of the chewing gum indicated that levels of 0.1%, 0.25%, and 0.5% Nisaplin resulted in chewing gum with reduced bitterness and more sugar-like quality, having a syrupy mouth feel. At higher levels of Nisaplin, a saltiness detrimental to the bubble gum flavor was observed.

EXAMPLES 17-20

A wintergreen flavored gum was prepared having the following composition:

Ingredient	% By Weight
Gum Base	26.80
Sorbitol	45.70
Mannitol	8.00
Coevaporated Lycasin\Glycerin*	9.10
Glycerin	7.70
Flavors	2.30
Encapsulated Sweeteners	0.24
Colors	0.11
10% Salt Solution**	0.05
TOTAL	100.00

* Contains about 67.5% Lycasin brand hydrogenated starch hydrolate solids, about 25% glycerin, and about 7.5% water

** Contains 10% sodium chloride and 90% water

The above chewing gum composition was divided into four 50 gram portions. The portions were then mixed with levels of 0.1%, 0.25%, 0.5%, and 1.0% Nisaplin. Sensory evaluation of the chewing gum indicated that levels of 0.1%, 0.25%, and 0.5% Nisaplin resulted in chewing gum with reduced bitterness and more sugar-like quality, having a syrupy mouth feel. At higher levels of Nisaplin, a saltiness detrimental to the flavor was observed.

Based on the foregoing, it was concluded that the addition of small amounts of nisin or Nisaplin to chewing gum compositions causes noticeable improvements in flavor and mouth feel of chewing gum. The addition of small amounts of nisin or Nisaplin suppress bitterness and enhance the flavor of chewing gum products.

It should be appreciated that the methods and compositions of the present invention are capable of being incorporated in the form of a variety of embodiments, only a few of which have been illustrated and described above. The invention may be embodied in other forms without departing from its spirit or essential characteristics. It will be appreciated that the addition of some other ingredients, process steps, materials or components not specifically included will have an adverse impact on the present invention. The best mode of the invention may therefore exclude ingredients, process steps, materials or components other than those listed above for inclusion or use in the invention. However, the described embodiments are to be considered in all respects only as illustrative and not restrictive, and the scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

WE CLAIM:

1. A chewing gum product having an improved flavor comprising:

a) about 5% to about 95% gum base;

b) about 5% to about 95% bulking and sweetening agents;

c) about 0.1% to about 15% flavor;

d) a minor amount of nisin, the nisin being present in an amount sufficient to provide the gum product with a suppressed bitterness and an enhanced flavor.

2. The chewing gum product of claim 1 wherein the bulking and sweetening agents comprise sugar and corn syrup.

3. The chewing gum product of claim 1 wherein the chewing gum is sugarless chewing gum.

4. The chewing gum product of claim 1 wherein the nisin is present at a level of about 12.5 ppm to about 187.5 ppm by weight of the total gum product.

5. The chewing gum product of claim 1 wherein the nisin is added to the gum in the form of a mixture comprising sodium chloride, denatured milk solids and about 2.5% nisin.

6. The chewing gum product of claim 5 wherein said mixture is present at a level of about 0.05% to about 0.75% by weight of the total gum product.

7. The chewing gum product of claim 5 wherein the chewing gum comprises high-intensity sweeteners.

8. The chewing gum product of claim 7 wherein said mixture is present at a level of about 0.05% to about 0.75% by weight of the total gum product.

9. The chewing gum product of claim 7 wherein said mixture is present at a level of about 0.1% to about 0.5% by weight of the total gum product.

10. The chewing gum product of claim 5 wherein the bulking and sweetening agents comprise sugar and corn syrup and said mixture is present at a level of about 0.05% to about 0.5% by weight of the total gum product.

11. The chewing gum product of claim 10 wherein said mixture is present at a level of about 0.1% to about 0.25% by weight of the total gum product.

12. The chewing gum product of claim 1 wherein the nisin is encapsulated with a fast release agent.

13. The chewing gum product of claim 1 wherein the nisin is encapsulated with a delayed release agent.

14. The chewing gum product of claim 1 wherein the product is a liquid center filled product, and the nisin is present in the liquid center of the product.

15. The chewing gum product of claim 1 wherein the nisin is present in a dusting compound used on the product.

16. The chewing gum product of claim 1 wherein the nisin is present in a shell coating applied to the gum.

17. A method of making a chewing gum product with improved flavor comprising the steps of:

a) mixing about 5% to about 95% gum base, about 5% to 95% bulking and sweetening agents, and about

0.1% to about 15% flavor to form a chewing gum composition;

b) while making the gum composition, adding nisin in an amount sufficient to provide the gum composition with a suppressed bitterness and an enhanced flavor.

18. The method of claim 17 wherein the nisin is encapsulated with a fast release agent before being mixed into the gum composition.

19. A method of making a liquid center filled chewing gum product with improved flavor comprising the steps of:

a) mixing about 5% to about 95% gum base, about 5% to 95% bulking and sweetening agents, and about 0.1% to about 15% flavor to form a chewing gum composition;

b) making a liquid center composition comprising nisin;

c) forming a chewing gum product, having a liquid filled center, from the chewing gum composition and including the liquid center composition in the product.

20. A method of making a chewing gum product with improved flavor comprising the steps of:

a) mixing about 5% to about 95% gum base, about 5% to 95% bulking and sweetening agents, and about 0.1% to about 15% flavor to form a chewing gum composition;

b) making a dusting compound comprising nisin;

c) applying the dusting compound to the chewing gum composition during a process comprising the steps of product formation and wrapping.

21. A method of making a chewing gum composition with improved flavor comprising the steps of:

a) mixing about 5% to about 95% gum base, about 5% to 95% bulking and sweetening agents, and about 0.1% to about 15% flavor to form a chewing gum composition;

b) making a coating mixture comprising nisin;

c) coating pellets of the chewing gum composition with the coating mixture to form a coating on the pellets.

22. The method of claim 21 wherein the coating mixture comprises a coating syrup and the coating comprises a hard shell coating.

INTERNATIONAL SEARCH REPORT

Int. ational application No.
PCT/US95/15688

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A23G 3/30
US CL :426/3
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/3, 4, 5, 6, 650, 651

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS
search terms: chewing gum, nisin, bitterness, flavor, polypeptide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,597,972 (TAYLOR) 01 July 1986.	1-22
Y	US, A, 5,082,653 (PAN ET AL) 21 January 1992, see entire document.	1-22
Y	US, A, 5,368,845 (GAFFAR ET AL) 29 November 1994, see entire document.	1-22

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

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